United States
Consumer Product Safety Commission

Micromobility Products-Related Deaths, Injuries, and Hazard Patterns: 2017–2023

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James Tark

Directorate for Epidemiology

Division of Hazard Analysis

This report was prepared by the CPSC staff. It has not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

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Executive Summary

In this report, U.S. Consumer Product Safety Commission (CPSC) staff presents the latest available statistics on injury estimates, fatalities, and hazard patterns associated with three micromobility products: e-scooters (including dockless/rental e-scooters), hoverboards, and e-bikes. The timeframe covered is 2017 through 2023. This report includes all data presented in the previous annual report, Micromobility Products-Related Deaths Injuries and Hazard Patterns 2017-2022[1] and adds the 2023 data and the findings from a 2023 special study of e-scooter-related injuries. For micromobility-related fatalities, staff notes that, due to delays in death certificate reporting, the number of reported fatalities may change in the future.

Staff found that the proportion of estimated injuries sustained by non-Hispanic Black consumers (among the 76% of ED visits from 2019-2023 with known race/ethnicity) was 27 percent for overall micromobility, 30 percent for e-scooters, and 29 percent for e-bikes, which are substantially higher proportions than the 13 percent of the U.S. population that are non-Hispanic Black.

Key data and findings of this report are summarized below.

Reported Fatalities[2]

- All Micromobility Products
  - CPSC staff is aware of 373 fatalities from 2017 through 2023.
  - The number of fatalities has been increasing steadily from 5 in 2017, to 117 in 2023.

- E-Scooters
  - CPSC staff is aware of 164 (18 dockless/rental) fatalities from 2017 through 2023.[3]
  - Motor vehicle accidents and control issues were top hazards associated with e-scooter fatalities.
  - Out of the 164 fatalities, 15 were associated with 11 incidents of lithium-ion battery-related fires.

- Hoverboards
  - CPSC staff is aware of 16 fatalities from 2017 through 2023.

[1] The report, Micromobility Products-Related Deaths Injuries and Hazard Patterns 2017-2022 can be found at: https://cpsc.gov/content/Micromobility-Products-Related-Deaths-Injuries-and-Hazard-Patterns-2017%E2%80%932022.
[2] Reporting for 2022-2023 is ongoing. Counts may change in future reports.
[3] Fatality reports associated with dockless e-scooters began to appear in the CPSC surveillance data in 2018.

- Out of the 16 fatalities, 11 fatalities were associated with 5 incidents of lithium-ion battery-related fires.

- E-Bikes
- CPSC staff is aware of 193 fatalities from 2017 through 2023.
- Motor vehicle accidents and control issues were top hazards associated with e-bike fatalities.
- Out of the 193 fatalities, 14 were associated with 8 incidents of lithium-ion battery-related fires.

Emergency Department (ED) - Treated Injury Estimates

- All Micromobility Products
- Estimated total of 448,600 ED visits from 2017 through 2023;
- An increasing linear trend was detected for emergency department (ED) visits associated with micromobility products, which is a statistically significant increase in injuries.

- E-Scooters
- Estimated total of 209,600 ED visits from 2017 through 2023;
- An increasing linear trend was detected for ED visits associated with e-scooters, which is a statistically significant increase in injuries;
- Estimated ED visits associated with dockless/rental e-scooters in the same timeframe is 37,200, accounting for 18 percent of ED visits for e-scooters.[4] However, this is likely an underestimate because not all dockless/rental e-scooters may have been identified as dockless/rental in the NEISS data by the hospital staff.

- Hoverboards
- Estimated total of 151,600 ED visits from 2017 through 2023;
- A decreasing linear trend was detected for ED visits associated with hoverboards in the same timeframe, which is a statistically significant decrease in injuries.

[4] The estimate for dockless/rental e-scooters is based on NEISS data (2018-2023) and special studies (2020-2023).

- E-Bikes
- Estimated total of 87,400 ED visits from 2017 through 2023, accounting for 19 percent of the overall micromobility injury estimate in the same timeframe;
- The annual estimated ED visits for e-bikes did not meet the reporting criteria for each individual year from 2018 to 2021. [5] The number of ED visits for e-bikes has increased nearly 10-fold from 2017 to 2023.

Special Study on E-Scooters

- CPSC staff successfully followed up 411 e-scooter NEISS injury cases that occurred in 2023 through investigations.
- Rental e-scooters accounted for 40 percent of the e-scooter-related ED visits in the special study.
- Sixty percent of the injuries occurred on paved roads.
- Twenty-five percent of the victims reported that the visibility factor may have contributed to the accidents.
- Five percent of the victims reported that a source of distraction, such as music/cell phone/loud music while riding e-scooter may have contributed to the accidents.
- Thirty-three percent of the injured were carrying or holding something while riding the e-scooter.
- Sixteen percent of the riders were wearing a helmet; and of 10,100 injuries where it was reportedly dark/difficult to see, 6,000 (59%) were wearing blinking lights/headlamps or reflective vests.

Associated Hazard Patterns

CPSC Field staff completed 441 follow-up in-depth investigations related to all micromobility products, based on reports of incidents in CPSC's Consumer Product Safety Risk Management System (CPSRMS) [6] that occurred from 2017 through 2023. Of the 441 completed investigations, 143 involved an e-scooter, 191 involved a hoverboard, and 107 involved an e-bike. These investigations based on CPSRMS reports were in addition to the 2023 special study of e-scooter incidents that were reported through NEISS.

[5] Refer to Appendix B for NEISS reporting criteria.
[6] Reports in CPSRMS come from various sources, including consumer complaints, news clips, state/local authorities, medical examiners, death certificates from the states, manufacturers, and retailers, among others.

- E-Scooters
  - One hundred forty-three of the investigated incidents involved an e-scooter (32 of the 143 were dockless/rental e-scooters).
  - Fire hazards were the most common problem reported, accounting for 69 of the 143 investigated incidents.
  - Brake problems were associated with 32 of the investigated incidents.

- Hoverboards
  - Field staff investigated 191 incidents associated with hoverboards.
  - The top two common problems reported were fire hazards with 167, followed by 21 other electrical hazards.

- E-Bikes
  - CPSC staff reviewed 107 completed investigation reports on e-bikes.
  - The top two common problems reported were fire hazards with 75, followed by miscellaneous product-related issues with 25.

Introduction

The use of micromobility products, particularly e-scooters and e-bikes, has increased in recent years with advancements in battery technology and the growing popularity of commercial ride-sharing services. Consumers may rent commercial, dockless e-scooters and e-bikes or purchase their own micromobility products. These products are popular with consumers because they are perceived as eco-friendly, given that they have no tailpipe emissions, and they are a convenient, cost-effective mode of transportation for short-distance travel.[7] In addition, no motor vehicle license is required to operate these products.

This report summarizes the deaths, injuries, and hazards associated with the use of micromobility products, based on data from the CPSC epidemiological databases from 2017 through 2023. Data from 2023 were added to the data from 2017 through 2022 previously presented in the 2023 annual report on micromobility products.[8] In addition, this report summarizes findings from a special follow-up study of emergency department-treated injuries involving e-scooters in 2023. The micromobility products covered in this report are:

- electric scooters (e-scooters: electric-powered, motorized standing scooters), including ride-sharing dockless/rental e-scooters;
- hoverboards (also referred to as self-balancing e-scooters that are electric-powered, two-wheeled standing scooters with no handlebars); and
- low-speed electric bicycles (or e-bikes), defined in section 38 of the Consumer Product Safety Act, 15 U.S.C. § 2085 as a two- or three-wheeled vehicle with fully operable pedals and an electric motor of less than 750 watts (1 h.p.), whose maximum speed on a paved level surface, when powered solely by such a motor while ridden by an operator who weighs 170 pounds, is less than 20 mph.

Electric unicycles, three-wheeled e-scooters, non-electric kick scooters, gas-powered scooters, mobility scooters, mopeds, motorized carts, and other seated motorized scooters are not in scope for this report.

The first section of this report presents the fatalities reported to CPSC for micromobility products. This is followed by a section on the national injury estimates in the following order: overall micromobility, e-scooters, hoverboards, and e-bikes. The individual injury estimates for dockless/rental e-scooters were not presented in this report, due to small sample sizes, high coefficient of variation (CV), and limitations in NEISS[9] data possibly leading to undercounts because of the unavailability of sufficient information to identify the product as a dockless/rental. This is followed by a section on the special study of e-scooter-related injuries. The special study section is followed by a section on the hazard patterns, the analysis is presented for overall micromobility, then e-scooters (dockless/rental e-scooter statistics in parentheses), hoverboards, and finally, for e-bikes. Lastly, Appendix A describes staff's methodology, including the process for data extraction, scope determination, and discussion of the raking

[7] See https://www.cpsc.gov/s3fs-public/safety-concerns-associated-with-micromobility-products.
[8] The report, Micromobility Products-Related Deaths Injuries and Hazard Patterns 2017-2022 can be found at: https://cpsc.gov/content/Micromobility-Products-Related-Deaths-Injuries-and-Hazard-Patterns-2017%E2%80%932022
[9] See https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data.

methodology. Appendix B presents additional details about the injury estimates and trend analysis. Appendix C includes the updated 2023 special study results with the 24 additional cases completed since the last report. Appendix D lists the questions used in the follow-up study of NEISS on e-scooter-related injuries treated.

The fatality statistics, as well as the hazard pattern review staff presents in this report, are based on incidents reported to CPSC through the CPSC's Consumer Product Safety Risk Management System (CPSRMS). See Appendix A for the codes and keywords used in the database searches. Reports in CPSRMS come from various sources, including consumer complaints, news clips, state/local authorities, medical examiners, death certificates from the states, manufacturers, and retailers, among others. Staff considers the data in CPSRMS to be anecdotal and not nationally representative. Moreover, data collection is ongoing, and staff considers the later years' data to be incomplete. Specifically, for death statistics, which rely on death certificates reported by the states, staff observes a lag of up to 2 years from the time of the death to the time of reporting to the CPSC. As such, the data included in this report (especially from 2022 through 2023) are likely incomplete. Each incident report contains a product code that identifies the type of product involved, as well as information about the location of the incident (state and city) and the individual(s) involved or injured (age and sex), and a narrative description.

Staff's national estimates of injuries are based on injury data collected by CPSC's NEISS, which is a nationally representative stratified probability sample of hospitals in the United States and its territories. Each injury report contains a product code that identifies the type of product involved; in addition, information on the injured victim's sex, age, diagnosis, disposition, body part injured, and a brief narrative description of the injury is available. Each injury in the sample represents an estimated number of injuries that staff projects nationally.

CPSC staff conducted a special follow-up study of NEISS on e-scooter-related injuries treated in hospital emergency departments between January 1, 2023, and December 31, 2023. These investigations were completed through telephone interviews and self-administered online surveys of injured victims to learn more about how the injury occurred, the type of injury, the scooter type involved, the characteristics of the rider/victim, and the incident scenario.

I. Reported Fatalities Associated with Micromobility Products

CPSC staff is aware of 373 fatalities related to micromobility products that occurred in the United States during the 7-year timeframe, 2017 through 2023. Some of the characteristics of these reported fatalities are summarized in the tables below. Due to delays in death certificate reporting, staff expects the number of reported fatalities for these years to change in future reports. Compared to the last annual report, there are 140 additional fatalities. [10] Out of the 140 fatalities, 87 e-bikes and 53 e-scooter-related fatalities were reported in 2021 through 2023.

[10] Staff found two incidents involving three fatalities were duplicates in the last annual report. They have been removed in this report.

Table 1.1 shows the fatality data for micromobility products by incident year from 2017 to 2023. While data reporting is ongoing, as of the writing of this report, staff identified 373 fatalities involving micromobility products. E-scooter-related fatalities represent 164 (18 were dockless e-scooter-related) out of 373 (44 percent) total fatalities. E-bikes account for 193 (52 percent) of total fatalities, increasing substantially during the 7-year timeframe. CPSC staff is aware of 16 fatalities involving hoverboards during the same period.

Table 1.1: Number of Reported Fatalities Associated with Micromobility Product Type and Year

Year	All Micromobility	E-Scooter (Dockless/rental)	Hoverboard	E-Bike
2017	5	1	4	0
2018	11	5(2)	0	6
2019	31	25 (7)	0	6
2020	35	16(2)	2	17
2021	83	40](4)	8	35
2022	91	36(3)	2	53
2023	117	41 (0)	0	76
Total	**373**	**164(18)**	**16**	**193**

Note: Reporting for 2022-2023 is ongoing. Counts may change in future reports.
Source: CPSRMS, NEISS, U.S. Consumer Product Safety Commission, 2017-2023.

Among the 373 micromobility-related fatalities, 291 were male decedents, 65 were females, and sex was unknown/other for the remaining 17 decedents. Decedents were males in most of the fatalities related to e-scooters (129, including 16 dockless e-scooter fatalities, out of 164), and e-bikes (157 out of 193); of the 16 hoverboard-related fatality victims, 11 were females. The distribution of decedents by product type by gender distribution is presented in Table 1.2.

Table 1.2: Number of Reported Fatalities Associated with Micromobility Product Type and Sex (2017–2023 Total)

Sex	All Micromobility	E-Scooter (Dockless/rental)	Hoverboard	E-Bike
Male	291	129 (16)	5	157
Female	65	23 (2)	11	31
Unknown/Other	17	12 (0)	0	5
Total	**373**	**164 (18)**	**16**	**193**

Note: Reporting for 2022-2023 is ongoing. Counts may change in future reports.
Source: CPSRMS, NEISS, U.S. Consumer Product Safety Commission, 2017-2023.

Table 1.3 presents the fatality data for micromobility by product type and age group of the deceased from 2017 to 2023. Staff included the general U.S. population distribution corresponding to the average of the 7 years, 2017–2023. Three hundred thirty-one out of 373 total reported micromobility fatalities provided age information. Of these 331 fatalities, 118 (36 percent) were 25-44 years old, which was disproportionately high compared to its proportion in the general U.S. population. Of the 118 fatalities in the 25-44 age group, 59 involved e-scooters, 56 e-bikes, and 3 hoverboards. Of the 62 fatalities within the 65 and older age group, 49 (79 percent) involved e-bikes.

Table 1.3: Reported Fatalities Associated with Micromobility Product Type and Age Group (2017–2023 Total)

Age Group	U.S. Population	All Micromobility	E-Scooter (Dockless/rental)	Hoverboard	E-Bike
Under 5	6%	4	1 (0)	3	0
5–14	12%	15	6 (0)	5	4
15-24	13%	50	31 (5)	2	17
25-44	27%	118	59 (6)	3	56
45-64	25%	82	30 (2)	1	51
65 and older	17%	62	11 (2)	2	49
Unknown	N/A	42	26 (3)	0	16
Total	**100%**	**373**	**164 (18)**	**16**	**193**

Note: Reporting for 2022-2023 is ongoing. Counts may change in future reports.
Source: CPSRMS, NEISS, U.S. Consumer Product Safety Commission, 2017-2023.

Table 1.4 shows the data for micromobility-related fatalities by product and hazard types. Out of the 373 fatalities reported to CPSC staff, 164 (18 dockless/rental e-scooters) deaths involved e-scooters, 16 involved hoverboards, and e-bikes accounted for 193 of these deaths.

E-Scooters (Including Dockless/Rental E-Scooters)

Staff's review of the 164 fatalities shows the following hazards:

- Motor vehicle accidents were the leading cause of death associated with e-scooters. Out of the 164 fatalities reported to CPSC staff, 107 deaths (including 13 on dockless/rental e-scooters) involved motor vehicle accidents (*e.g.*, collision with cars, SUVs, buses, or trucks).
- Twenty-one e-scooter fatalities (including 5 on dockless/rental e-scooters) were due to control issues. Control issues led to crashing into a fixed object and striking pavement or road curbs.
- Fifteen fatalities were associated with e-scooter battery-related fires. In all 15 fatalities, batteries that powered scooters sparked the fire.
- Accidents involving pedestrians resulted in 4 fatalities; all 4 decedents were struck by e-scooter riders.
- Other hazards accounted for 2 fatalities, both of which were associated with intoxication, including one which involved a crash with a commuter train while riding the e-scooter and the other in an incident in which fell from e-scooter while intoxicated.
- Unspecified falls accounted for 15 e-scooter-related fatalities; staff does not have sufficient scenario-specific information to determine what caused the falls.

Hoverboards

Staff's review of the 16 hoverboard-related fatalities shows the following hazards:

- Eleven fatalities were associated with hoverboard-related fires, where 4 deaths involved flame eruptions while charging the hoverboards, and the other 7 deaths have no information.
- Two deaths were caused by motor vehicle accidents. In separate incidents, 2 hoverboard riders were struck by vehicles.
- Unknown falls accounted for 3 hoverboard-related fatalities; staff does not have sufficient scenario-specific information to determine what caused the falls.

E-Bikes

Staff's review of the 193 fatalities shows the following hazards:

- Collisions with motor vehicles were the leading cause of death associated with e-bikes, accounting for 113 reported deaths.
- Thirty-one e-bike fatalities were due to control issues, such as crashing into other fixed objects (*i.e.*, gate, sign, post, barricade, railing, dumpster, median, fence) or striking road curbs.
- Fourteen fatalities were associated with lithium-ion battery-related fires, where 7 deaths were associated with manmade battery packs or bike repair shops; 2 deaths involved flame eruptions while charging the e-bikes, and one where the e-bike had fallen into the water; the other 4 deaths have no charging information.
- Accidents involving pedestrians resulted in 10 fatalities; 8 pedestrians were struck by e-bikes and died from blunt impact/fall, and 2 e-bike riders were killed due to blunt impact caused when they struck pedestrians.
- In 2 of the 195 fatalities, e-bike riders were intoxicated at the time of the accident.
- One fatality was due to the rider hitting a speed bump and becoming airborne, then crash-landing.
- Unknown falls accounted for 22 e-bike-related fatalities, but staff does not have sufficient scenario-specific information to determine what caused the falls.

Table 1.4: Reported Fatalities Associated with Micromobility Product Type and Associated Hazards (2017–2023 Total)

Hazard Pattern	All Micromobility	E-Scooter (Dockless/rental)	Hoverboard	E-bike
Motor vehicle accident	222	107 (13)	2	113
Control issues	52	21 (5)	0	31
Fire hazards	40	15	11	14
Pedestrian accident	14	4	0	10
Pavement	1	0	0	1
Other	4	2	0	2
Unspecified falls	40	15	3	22
Total	**373**	**164 (18)**	**16**	**193**

Note: Reporting for 2021-2023 is ongoing. Counts may change in future reports.
Source: CPSRMS, NEISS, U.S. Consumer Product Safety Commission, 2017-2023.

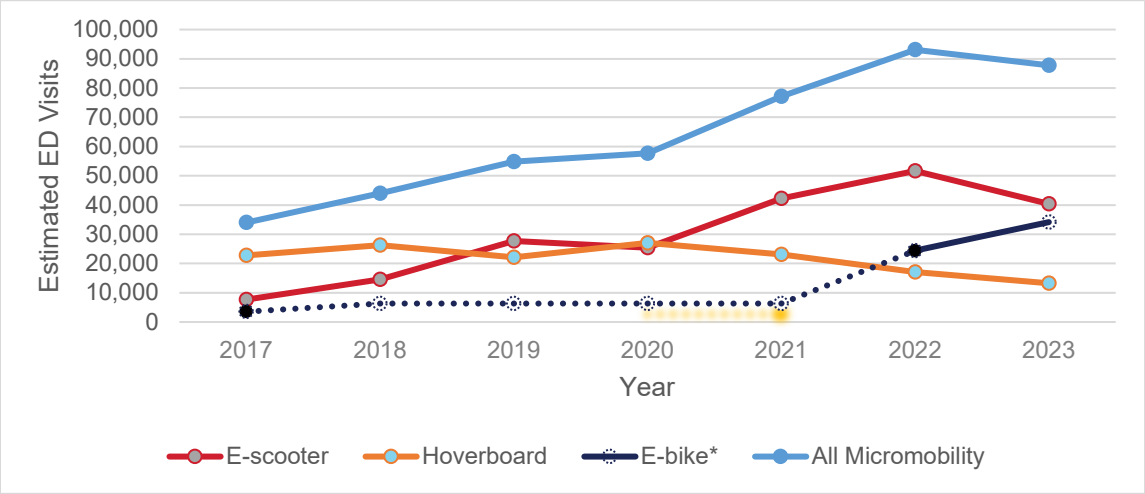
II. National Injury Estimates

Staff estimates 448,600 injuries related to all micromobility products were treated in U.S. emergency departments over the 7-year period 2017 through 2023. The annual estimates for 2024 are not available until NEISS data for 2024 are finalized in the spring of 2025. The estimated ED visits associated with micromobility increased from 34,000 in 2017 to 87,800 in 2023, which is statistically significant (p-value < 0.01).

Products

Figure 2.1 shows the national annual estimates of ED-treated micromobility injuries and product types from 2017 through 2023. From 2017 through 2023, a linear trend was detected for overall emergency department (ED) visits associated with micromobility, which is statistically significant (p-value < 0.01). Comparing 2023 to 2022, it reflects a slight decrease of 6 percent from the 2022 estimate. In prior years, the ED-treated injury estimates reflected a statistically significant increase from 2017 to 2018 (p-value: 0.01), 2018 to 2019 (p-value: 0.05), as well as from 2021 to 2022 (p-value < 0.01). See Appendix B for additional details.

Figure 2.1: Estimated ED Visits Associated with Micromobility Products by Year



Source: NEISS, U.S. Consumer Product Safety Commission, 2017-2023.
*E-bike estimates are part of micromobility estimates. Data points for 2018 through 2021 are represented by the average for 2018-2021 as an intermediate dotted line since they do not meet the reporting criteria for NEISS.

Staff estimates that 209,600 injuries related to e-scooters were treated from 2017 through 2023. From 2017 through 2023, a linear trend was detected for ED visits associated with e-scooters, which is statistically significant (p-value: 0.01). The 2023 ED-treated injury estimate of 40,400 for e-scooters reflects a decrease of 22 percent from the 2022 estimate. There were statistically significant increases from 2017 to 2018 (p-value: 0.05), 2018 to 2019 (p-value: < 0.01), 2020 to 2021 (p-value: < 0.01), and 2021 to 2022 (p-value: <0.01) as well. The narratives in the 2017 NEISS data did not provide enough information for staff to identify any dockless/rental scooters; only the annual estimated ED visits for 2020 and 2022 meet the reporting criteria, where the NEISS narrative provided enough information to determine that the product was a dockless/rental e-scooter, did not meet minimum requirement for reporting. Moreover, it is likely that NEISS estimates on dockless/rental e-scooters are underestimates, due to insufficient information present to identify the product as a dockless/rental. Some information on this is provided in the special study discussed later in this report.

Staff estimates 151,600 ED-treated visits for hoverboards from 2017 through 2023. From 2017 through 2023, a linear trend was detected for ED visits associated with hoverboards, which is statistically significant (p-value: < 0.01). The 2023 ED-treated injury estimate of 13,300 for hoverboards reflects a decrease of 22 percent from the 2022 estimate. The 2022 ED-treated injury estimate of 17,100 for hoverboards reflects a decrease of 26 percent from the 2021 estimate, which is statistically significant (p-value < 0.01).

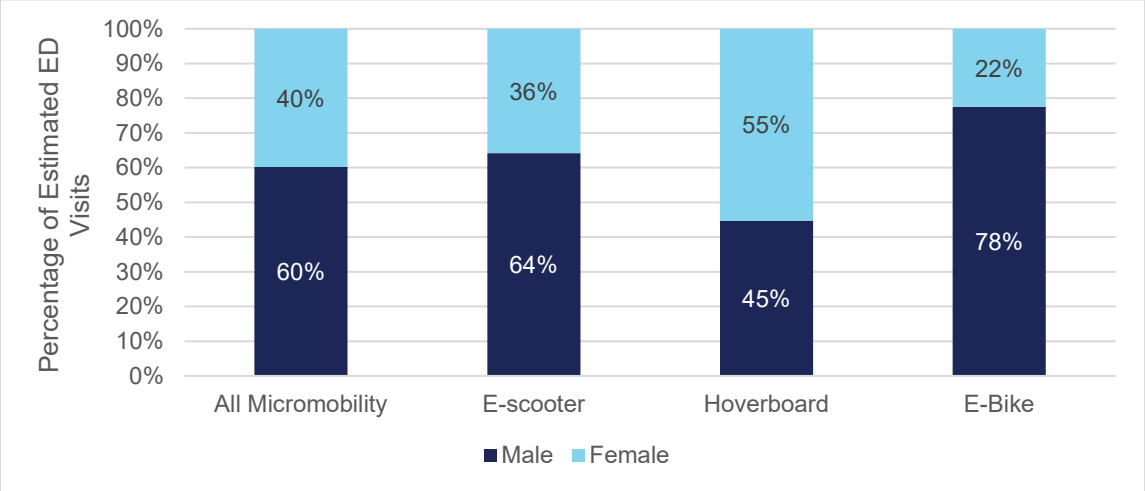
Staff estimates 87,400 ED-treated visits for e-bikes from 2017 through 2023. The 2023 ED-treated injury estimate of 34,200 for e-bikes reflects an increase of 10,000 ED visits from the 2022 estimate, which is statistically significant (p-value < 0.01). The 2022 ED-treated injury estimate of 24,400 for e-bikes reflects an increase of 21,000 ED visits from the 2017 estimate, which is statistically significant (p-value < 0.01). The number of ED visits for e-bikes has increased nearly 10-fold from 2017 to 2023 and the estimate for 2023 ED visits represents 39% of the estimate for the 7-year period of 2017 through 2023. Staff determined that the annual

estimated ED visits for e-bikes did not meet the reporting criteria for 2018 through 2021. Refer to Appendix B for details. Staff estimates the e-bikes' share of estimated ED-treated injuries for all micromobility products to be about 19 percent over the 7-year period.

Sex

Figure 2.2 shows the distributions of estimated micromobility-related injuries by product type and sex. Males experienced a higher percentage of micromobility-related, ED-treated injuries in e-scooters (64 percent) and e-bikes (78 percent) during the 7-year period. In contrast, females had a higher percentage (55 percent) of hoverboard-related, ED-treated injuries.

Figure 2.2: Distribution of Estimated ED Visits Associated with Micromobility by Product Type and Sex (2017–2023 Total)



Source: NEISS, U.S. Consumer Product Safety Commission, 2017-2023.

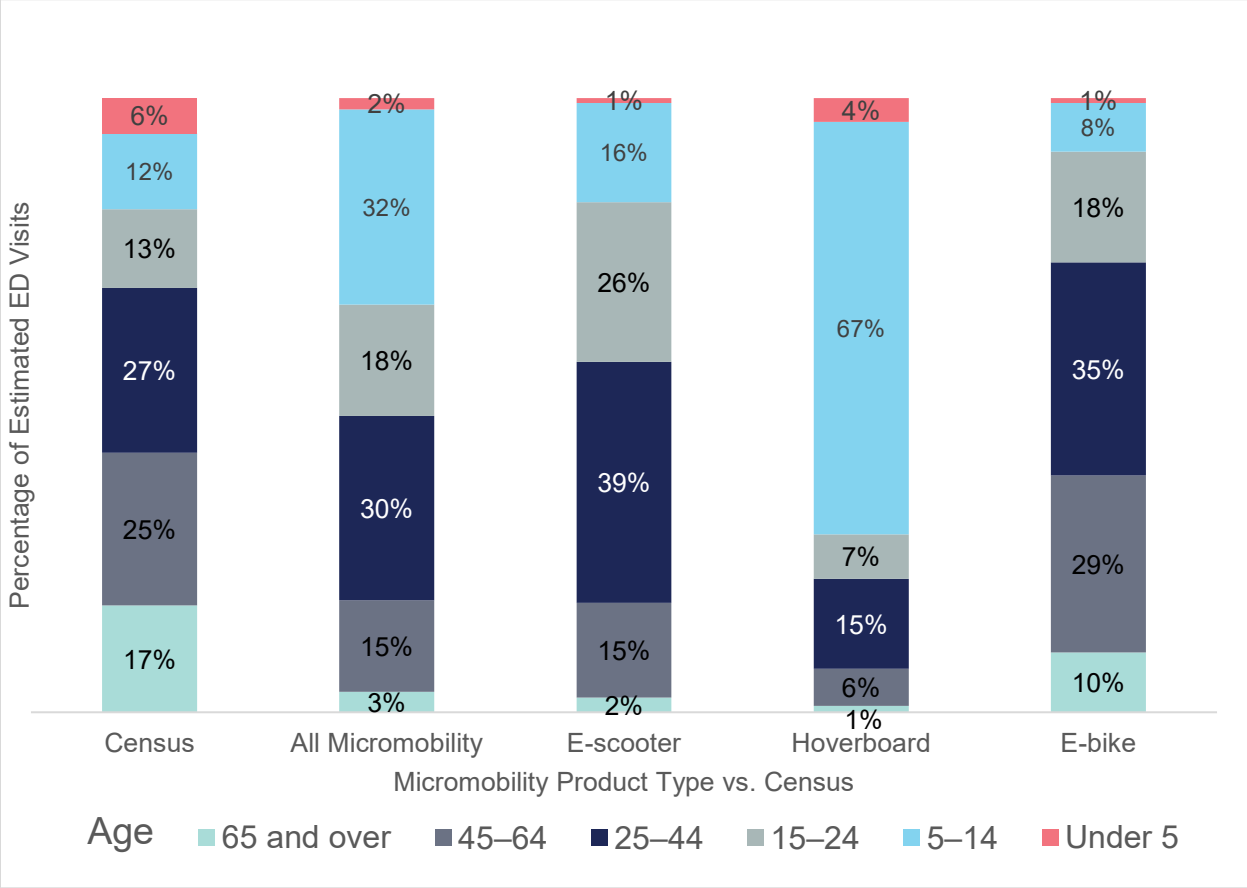
Age Groups

Figure 2.3 shows the distribution of estimated micromobility-related injuries by age from 2017 through 2023, versus the general U.S. population distribution. Staff obtained the population by age data from the U.S. Census Bureau,[11] corresponding to the average of 7 years, 2017–2023. The distributions of estimated injuries sustained by the 15-to-24 and 25-to-44 age groups were 26 percent and 39 percent, respectively, for e-scooters. These distributions were disproportionately high compared to their proportions in the general U.S. population (13 percent and 27 percent, respectively). Similarly, the percentage of estimated hoverboard-related injuries for the 5-to-14 age group (67 percent) was disproportionately high, compared to its proportion in the general U.S. population (12 percent). The percentage of estimated e-bike related injuries for

[11] See https://www2.census.gov/programs-surveys/popest/datasets/2020-2022/national/asrh/.

the 65 and over age group (10 percent) was disproportionately high compared to other micromobility product types (2 percent for e-scooters and 1 percent for hoverboards).

Figure 2.3: Distribution of Estimated ED Visits Associated with Micromobility by Product Type and Age Group (2017–2023 Total) Compared to U.S. Population Age Distribution

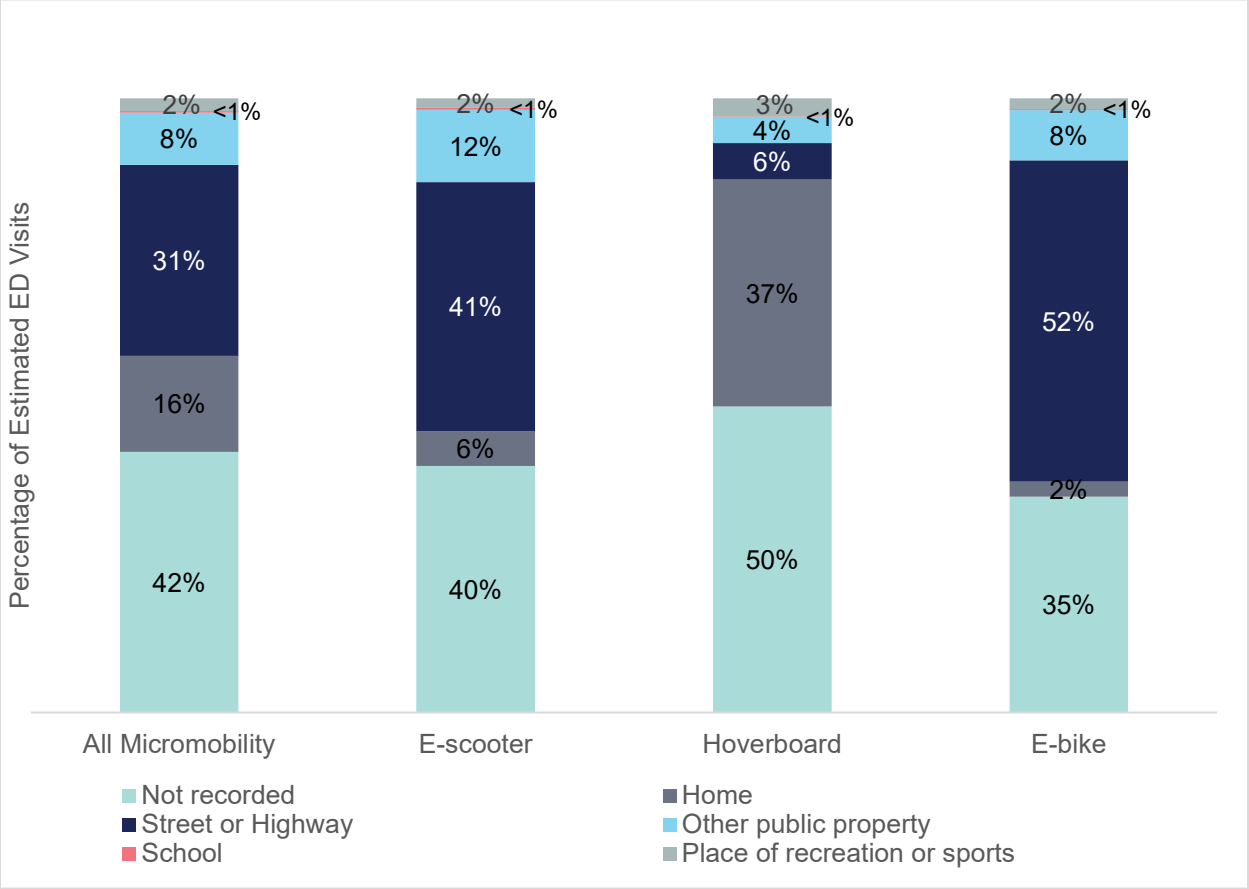


Source: NEISS, U.S. Consumer Product Safety Commission, 2017-2023.

Location of Injury

Figure 2.4 presents the proportions of injuries associated with micromobility by product type and location of injury. A large proportion (40 percent for e-scooters, 50 percent for hoverboards, 35 percent for e-bikes, and 42 percent overall) of estimated injuries occurred at unknown locations. For the known locations, the injuries associated with e-scooters and e-bikes occurred most frequently on streets or highways (41 percent and 52 percent, respectively); whereas the hoverboard-related injuries occurred most frequently at home (37 percent).

Figure 2.4: Distribution of Estimated ED Visits Associated with Micromobility Product Type and Location of Injury (2017–2023 Total)



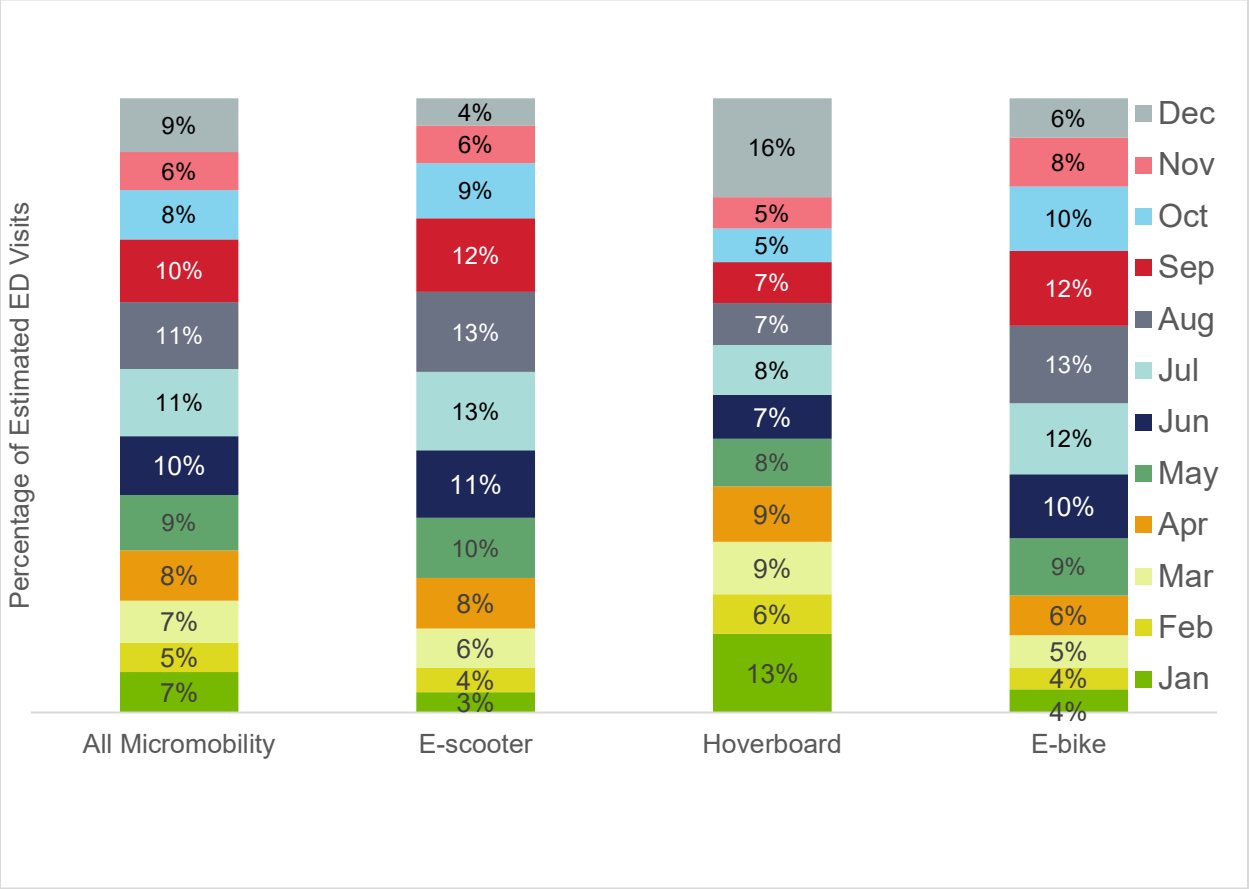
Source: NEISS, U.S. Consumer Product Safety Commission, 2017-2023.

Time of Year

Figure 2.5 illustrates the monthly percentage distribution of the estimated emergency visits by micromobility product type. If the distribution of ED visits were to follow the discrete uniform distribution,[12] the expected monthly ED visits would be around 8 percent. The months of May through October had the largest percentages for both e-scooter and e-bike ED visits whereas December and January had the largest percentages for hoverboard-related ED visits.

[12] The discrete uniform distribution is a symmetric probability distribution, where all 365 days are equally likely to be observed. Under that distribution, every month has a probability between 7.7 percent and 8.5 percent.

Figure 2.5: Distribution of Estimated ED Visits Associated with Micromobility Product Type and Month of Injury (2017–2023 Total)



Source: NEISS, U.S. Consumer Product Safety Commission, 2017-2023.

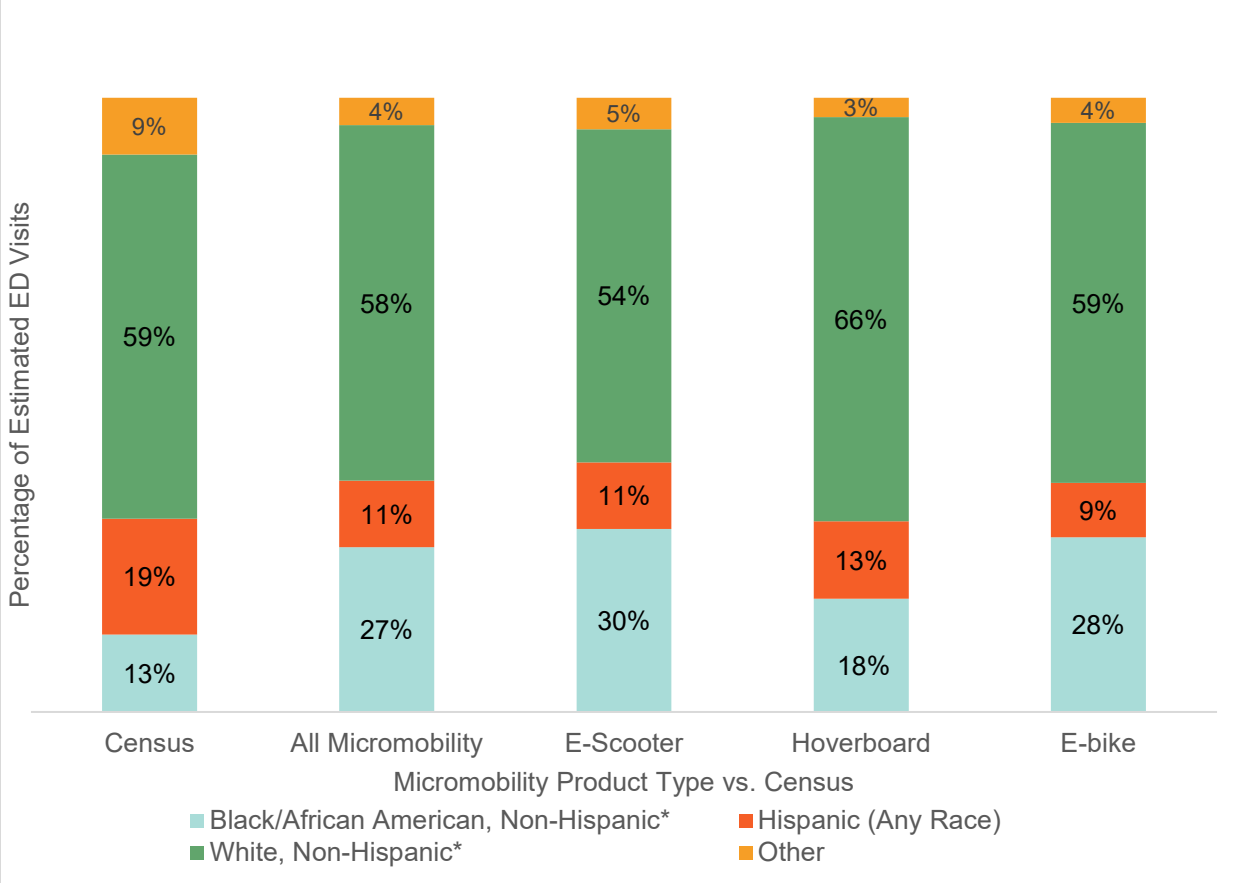
Race/Ethnicity Groups

NEISS data include three variables ("Race," "Raceoth," and "Hispanic") that record information about the race or ethnicity of ED-treated patients. These three variables were used when designating race/ethnicity categories for each patient. This resulted in five categories used for analysis on race/ethnicity in this report: (1) non-Hispanic Black or African American (Black), (2) non-Hispanic White (White), (3) Hispanic (Any Race), (4) all other patients with known races/ethnicities or who identify as Multiracial (Other), and (5) patients with an unknown race/ethnicity. This specific grouping aligns with the population data grouping presented by the U.S. Census Bureau.

As of the writing of this report, the Hispanic ethnicity variable has only been recorded for NEISS years 2019 through 2023. Therefore, analysis concerning race/ethnicity for the estimated number of ED-treated micromobility injuries is based on the years 2019 through 2023. Estimates of micromobility injuries involving races/ethnicities other than Black, Hispanic, or White are not statistically reliable for the data available, and hence, are not presented.

Figure 1.6 shows the distribution of estimated micromobility-related injuries versus the general U.S. population distribution by race/ethnicity from 2019 through 2023. The population data corresponding to the average of the 5 years, 2019–2023, are from the U.S. Census Bureau.[11] As the figure shows, the proportion of estimated injuries sustained by Black consumers was 27 percent for overall micromobility, 30 percent and 28 percent for e-scooters and e-bikes, respectively. These injuries suggest disproportionate impact compared to the proportion in the general U.S. population (13 percent Black Americans). However, staff notes some limitation in interpretation of the data presented in Figure 1.6 for two reasons. First, only 76 percent (280,700 out of 370,600) of the estimated micromobility injuries between 2019 and 2023 provided race/ethnicity information. Second, micromobility injuries (especially for e-scooters and e-bikes) are skewed towards younger (Figure 1.3) and possibly more urban sub-populations, and what reference basis of race/ethnicity baseline is applicable may depend on the purpose for which the data is being used.

Figure 2.6: Distribution of Estimated ED Visits Associated with Micromobility by Product Type and Race/Ethnicity, where known⁺, (2019–2023 Total) Compared to U.S. Population Race/Ethnicity Distribution



Source: NEISS, U.S. Consumer Product Safety Commission, 2019-2023.
Asterisks (*) indicate Race/Ethnicity designations are for reported single race only. The Other category includes the proportion of the U.S. population that are not counted among the non-Hispanic Black, Hispanic, or non-Hispanic White people in U.S. Census figures.
⁺Race/Ethnicity percentages are based on the known data which were available in only 76% of cases.

Other Characteristics

The remaining characteristics, which do not vary much by product type, are as follows:

- Fractures, followed by contusions/abrasions, are the two most common diagnoses.
- The most frequently injured body parts[13] are the upper and lower limbs, as well as the head and neck.
- Overall, 87 percent of the injured are treated and released from the EDs. About 9 percent are treated and admitted or transferred to another hospital. Disposition of the remaining 4 percent of injuries included "left without being seen," "held for observation," as well as fatalities.[14]

III. Special Study on E-Scooters

In response to the changing characteristics of markets for micromobility devices, CPSC revised the set of product codes used to describe scooters and powered skateboards (*e.g.* hoverboards) beginning in 2020. Previously two product codes 1329 (Scooters, unpowered) and 5042 (Scooters/skateboards, powered) were used to capture scooters and powered skateboards. However, this pair of codes created a conundrum for incidents and emergency department visits that only described a "scooter" without indicating whether the scooter was powered. In 2020, the set was replaced with 5022 (Scooters, powered), 5023 (Scooters, unpowered), 5024 (Scooters, unspecified), and 5025 (Hoverboards, and powered skateboards). To obtain more detailed information about the scooters associated with emergency department visits, CPSC staff initiated a series of special studies of scooter-related injuries, which continued through 2023.[15] This section focuses on the special study results for incidents from January 1, 2023 through December 31, 2023. More than 1,300 injury cases, coded as 5022 (Scooters, Powered) and 5024 (Scooters, Unspecified) were followed up through a survey questionnaire to obtain additional information on the scooter type involved, how the injury occurred, the type of injury, the characteristics of the rider/victim, and the incident scenario. The results showed 22 of the 56 incidents identified as 'Scooters, unspecified' were powered scooters. Recalibrating the weights for these cases (by taking the survey response rate into account), the 22 injury cases were added to all completed survey responses for injuries under product code 5022 (Scooters, powered). The e-scooter-related injuries (sample size = 411) from the special study were included as part of the 2023 estimate of 40,400 e-scooter injuries seen in emergency departments. In the investigations, information was requested directly from the victim (or the victim's parent, if the victim was a minor) about the type of scooter involved, where the scooter was obtained, and how the injury occurred.

[13] Body parts were grouped. For example, all body parts that would generally be considered a part of the lower limb (*e.g.,* toe, foot, ankle, knee, and leg) were grouped as "lower limb."
[14] Less than 0.1 percent of the estimated injuries were fatal. All fatal injuries from NEISS have been included in the fatality discussion of this report.
[15] Since the publication of the previous annual report in 2023, Staff received 24 additional e-scooter cases for the 2022 special study. The updated 2022 special study results are presented in Appendix C.

Scooter Types

Table 3.1 shows the number of respondents by verified scooter type and the corresponding NEISS product code in the special study. The respondents were asked a series of questions related to scooter type and different components. They were asked to provide information on the power source, whether it was an assisted mobility scooter, moped, motorcycle, or scooter that requires a registration or license. In addition, the respondents were asked if their scooter had steering handles and side-by-side wheels, as opposed to wheels that are one in front of the other. Of the 569 completed follow-up investigations on scooter-related incidents, 72 percent were e-scooters (411 out of 569), 7 percent were related to kick scooters, and the remaining 21 percent were other types of micromobility products. Of the 411 follow-up, e-scooter-related incidents, 95 percent were originally coded as powered scooters (389 out of 411), and 5 percent were coded as unspecified scooters (22 out of 411).[16]

Table 3.1: Scooter Products: NEISS Product Code vs. Verified Scooter Product (2023)

Verified Product	Overall	Powered Scooter (5022)	Unspecified Scooter (5024)	Other Product Codes
Kick (unpowered) Scooter	38	13	24	1
Mobility Scooter	34	33	0	1
Moped	31	26	3	2
Hoverboard	1	1	0	0
E-Scooter	411	389	22	0
Gas powered scooter	15	15	0	0
Other/missing	39	30	7	2
Total	569	507	56	6

Source: NEISS, U.S. Consumer Product Safety Commission, 2023.
Based on responses from the special study survey questions V3 – V8. See Appendix C for details.

Table 3.2 shows the response rate for e-scooter investigations by Overall, Powered, and Unspecified Scooter. Staff selected 1,319 cases from 2023 for investigation, of which 411 were completed and determined to be in scope, and 908 were either incomplete or out of scope. For the findings to be generalizable to all those injured, raking ratio estimation was implemented to create adjusted weights to reduce non-response bias due to differences in sex, race, stratum (hospital size), age category, and response rate. These benchmarked weights were used to produce the national estimates from the special study survey. See Appendix A for additional details.

[16] The 22 unspecified scooters have been included in the calculation of national injury estimates.

Table 3.2: Completed E-Scooter Investigations by Powered vs. Unspecified Scooter (2023)

Investigation	Overall	Percent	Powered Scooter (5022)	Percent	Unspecified Scooter (5024)	Percent
Completed Investigation	411	31%	389	30%	22	88%
Incomplete/Out of Scope	908	69%	905	70%	3	12%
Total Assigned	**1319**	**100%**	**1,294**	**100%**	**25**	**100%**

Source: NEISS, U.S. Consumer Product Safety Commission, 2023.

Estimated Injuries - Scenario-Specific Characteristics

In the remainder of this section, staff summarizes the 411 e-scooter cases from the follow-up investigations. They are descriptive of the portion that participated in the special study. Additionally, respondents did not respond to every question posed to them; as such, in the tables below, the "Unspecified" row was included to base all percentages on the total of 40,400 estimated injuries.

Table 3.3 shows the distribution of the estimated ED injuries based on the rental status of the e-scooter. Rental e-scooters accounted for 40 percent, while non-rental and unspecified e-scooters accounted for 60 percent.

Table 3.3: Distribution of Estimated Injuries by Rental Status (2023)

Rental vs Non-rental	N	Estimated ED-treated Injuries+	Percent
Rental	172	16,000	40%
Non-rental/Unspecified	239	24,300	60%
Total	**411**	**40,400**	**100%**

Source: NEISS, U.S. Consumer Product Safety Commission, 2023.
Based on the responses from special study survey question: *S1 Which of the following best describes the scooter? Rental, Owned by victim, Borrowed, Other, Don't know.*
+Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.

Table 3.4 shows the distribution of the estimated ED injuries while the victim was either riding the e-scooter or was struck by the e-scooter. Ninety-three percent of the injuries occurred to riders of the e-scooter.

Table 3.4: Distribution of Estimated Injuries by How Victim Was Injured (2023)

Riding/Struck by Scooter	N	Estimated ED-treated Injuries+	Percent
Riding the scooter	387	37,700	93%
Struck by scooter	11	*	*
Other/Unspecified	13	1,800	5%
Total	**411**	**40,400**	**100%**

Source: NEISS, U.S. Consumer Product Safety Commission, 2023.
Based on the responses from special study survey question: *V10 You/the victim were/was: Riding the scooter; Struck by scooter; Other.*
+Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.
*The reporting criteria for NEISS require that the estimated number of injuries be 1,200 or higher.

Table 3.5 shows the distribution of the ED visits based on the type of surface. Paved roads accounted for 60 percent and paved sidewalks for 30 percent.

Table 3.5: Distribution of Estimated Injuries by Type of Riding Surface (2023)

Type of Surface	N	Estimated ED-treated Injuries+	Percent
Paved road	241	24,000	60%
Paved sidewalk	126	12,000	30%
Driveway	4	*	*
Other	21	2,400	6%
Unspecified	30	2,800	7%
Total	**411**	**40,400**	**100%**

Source: NEISS, U.S. Consumer Product Safety Commission, 2023.
Based on the special study survey question: *A3 What type of surface were you/the victim on?*
+Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates; column values may not add up to column totals due to rounding or because some riders may have ridden e-scooter on more than one surface type.
*The reporting criteria for NEISS require that the estimated number of injuries be 1,200 or higher.

Table 3.6 shows the distribution of the injuries by responses on visibility (whether it was dark or difficult to see while riding the scooter). Twenty-five percent of the victims responded that it was dark or difficult to see.

Table 3.6: Distribution of Estimated Injuries by Visibility (2023)

Visibility Issues	N	Estimated ED-treated Injuries+	Percent
Yes	85	10,100	25%
No	297	27,800	69%
Unspecified	29	2,400	6%
Total	**411**	**40,400**	**100%**

Source: NEISS, U.S. Consumer Product Safety Commission, 2023.
Based on the special study survey question: *A5 Was it dark or difficult to see?*
+Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.

Table 3.7 shows the percentage breakout of the ED-treated injuries based on source of distraction, such as music, cell phone, or loud music, while riding the scooter. A source of distraction accounted for 5 percent of total injuries.

Table 3.7: Distribution of Estimated Injuries by Distraction (2023)

Distraction	N	Estimated ED-treated Injuries+	Percent
Yes	25	2,000	5%
No	359	36,200	90%
Unspecified	27	2,200	5%
Total	**411**	**40,400**	**100%**

Source: NEISS, U.S. Consumer Product Safety Commission, 2023.
Based on responses to the special study survey question: *A6 Was there anything else occurring at the time of the accident such as music, cell phone interference, or loud music?*
+Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.

Table 3.8 shows the percentage of ED-treated injuries based on whether the rider was carrying/holding something (*e.g.*, bag, purse, or backpack) while riding the scooter. Of the 40,400 estimated injuries with a response to this question, 33 percent of the injured were carrying or holding something while riding the scooter.

Table 3.8: Distribution of Estimated Injuries by Rider Baggage (2023)

Carrying/holding something	N	Estimated ED-treated Injuries+	Percent
Yes	142	13,100	33%
No	226	23,400	58%
Unspecified	43	3,800	9%
Total	**411**	**40,400**	**100%**

Source: NEISS, U.S. Consumer Product Safety Commission, 2023.
Based on responses to the special study survey question: *A8 Were/was you/the victim carrying or holding something such as a bag, purse, or backpack?*
+Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.

Table 3.9 shows the percentage of ED-treated injuries by usage of safety equipment such as a helmet, blinking lights, head lamp, knee pads, elbow pads, or reflective vest while riding the scooter. Because riders may use more than one type of safety equipment these rows do not add up to the total. Of the 40,400 estimated injuries where this information was available, the rider was wearing a helmet while riding the e-scooter 16 percent of the time, had blinking lights or head lamp 52 percent of the time, was wearing knee/elbow pads 3 percent of the time, and none of the above/unspecified represented 39 percent of responses. Out of 10,100 injuries due to "It was dark/difficult to see", 6,000 (59%) were wearing blinking lights/headlamps or reflective vests.

Table 3.9: Distribution of Estimated Injuries by Safety Equipment (2023)

Safety Equipment	N	Estimated ED-treated Injuries+	Percent
Helmet	66	6,500	16%
Blinking Lights/Head lamp	209	21,000	52%
Reflective vest	20	2,700	7%
Knee/elbow/wrist pads	9	1,300	3%
Other	12	*	2%
None of the above/ Unspecified	165	15,700	39%
Total	**411**	**40,400**	**100%**

Source: NEISS, U.S. Consumer Product Safety Commission, 2023.
Based on responses from the special study survey question: *S12 I'm going to read a list of safety equipment that riders might wear. Please tell me if the rider was wearing any of these at the time of the incident.*
Riders may use more than one type of safety equipment; as such, rows do not add up to the total.
+Injury estimates are rounded to the nearest 100. Percentages are calculated from the unrounded estimates.
*The reporting criteria for NEISS require that the estimated number of injuries be 1,200 or higher.

IV. Hazard Patterns Based on In-Depth Investigation Review

Given that the narratives available in NEISS focus on the injury sustained rather than on the circumstances leading to the injury, and the death reports only cover the fatalities reported, CPSC staff evaluated the available in-depth investigations for a more comprehensive look at how incidents happened. Based on reports of incidents in CPSRMS that occurred between 2017 and 2023, CPSC field staff completed 441 follow-up in-depth investigations related to all micromobility products. The 441 follow-up in-depth investigations cover non-injury incidents, non-fatal injuries, and 34 fatalities that have been discussed in the fatality section above. Of the 441 completed investigations, 143 involved an e-scooter (32 of the 143 were dockless/rental e-scooters); 191 involved a hoverboard; and 107 involved an e-bike (including 2 bike shop incidents). This does not necessarily reflect the current prevalence of incidents related to micromobility products in the CPSRMS database. Staff initiated many more in-depth investigations that could not be completed due to product unavailability or unwillingness of consumers to cooperate and provide product and injury information. Data collection is ongoing, and staff expects the numbers to change in future reports. Staff discusses the types of products and the reported hazards associated with each of the 441 investigations below.

E-Scooters (Including Dockless/Rental E-Scooters)

Of the 143 e-scooter-related incidents that were investigated, at least 32 were dockless e-scooters. Staff's review of the 143 in-depth investigations shows the following hazards:[17]

[17] Based on newly available information, one e-scooter incident that was included in the previously published annual report was deemed out of scope and is excluded in this report.

- **Fire hazard** was reported in 69 of the 143 incidents, which mostly occurred while charging the e-scooter (41 out of 69) and was accompanied by popping sounds, burning smells, battery sparks, explosions, or fires; in 13 separate incidents, the e-scooter battery sparked and caught spontaneous fire while the product was in a resting, non-charging state; an additional 4 incidents occurred while riding the e-scooter, with victims observing the battery emitting smoke, melting, starting on fire, or sparking; 2 incidents were associated with having issues with the scooter and then opening it up to expose the battery connections for a possible fix via battery reset or replacement; in 1 case, a victim powered on the e-scooter and it caught fire; in another case, the e-scooter was submerged in water causing battery cells to explode; and no other hazard information is available for the remaining 7 incidents.
- **Brake problem** was associated with 32 of the reported incidents. The investigations show that brakes not engaging at all, sporadically engaging, or engaging excessively following a delay resulted in 29 of the 32 reported incidents. In one other case, the complainant reported that the brake cable was not properly attached to the adjustment bracket on the handlebar grip. The remaining 2 incidents happened to the same consumer; other than an email message indicating mechanical brake failures, the consumer did not share any additional scenario-specific detail.
- **Multiple product-related issues** such as brakes malfunctioning, throttles getting stuck, control panels catching fire, wobbliness, and sudden acceleration were reported in 8 incidents. In one of these 8 incidents, the rider went over a bump, which seemed to mark the onset of throttle and brake problems.
- **Control factor, environmental factor, and unknown factor** played a role in 8 incidents. The users lost control of the e-scooters in 6 cases after hitting a pothole, hitting/coming off a curb, or while being chased by an aggressive dog. In one incident, Staff has insufficient information to determine why the users in the remaining 2 incidents went through an intersection against a red light, causing a collision with other motor vehicles that had the right-of-way.
- **Miscellaneous product-related issues** such as footboard breaking, handlebar, steering column, and front wheel detaching at the bottom part of the bar were reported in 18 incidents.
- **Unexpected power loss** caused the rider(s) to tip over or get thrown off in 5 reported incidents. In one of the 5 incidents the rider was going downhill, and the e-scooter lost power when it went over a curb.
- **Other electrical issues** were associated with 3 incidents. In an incident, a wheel began spinning on its own while the e-scooter was unattended. In another incident, the accelerator of an e-scooter got stuck in the on position. In 2 separate incidents, the accelerator of an e-scooter apparently got stuck in the acceleration position.

Hoverboards

A review of the 191 in-depth investigations showed the following hazards:

- **Fire** was the most common hazard identified with hoverboards, accounting for 167 of the 191 reports. The reports describe fire (sometimes after an explosion), smoke, or sparks emanating from the product; some reports describe the product overheating or melting. One hundred of the 167 fire/thermal incidents occurred when the board was being charged or had just completed charging; an additional 20 reported that the incidents occurred during use; another 16 hoverboard incidents occurred while the battery was in a resting, non-charging state; aftermarket battery chargers were reported in at least 9 of the incidents; 8 of the incidents transpired shortly after the product was powered on; in 6 different hoverboard incidents, victims reported sparks or fire when the consumer attempted to reset, remove, or replace the battery because the board was not charging. Staff had no scenario-specific information for the 8 remaining incidents.
- **Other electrical hazards** were identified in 21 of the 191 investigated incidents. These included the board spinning out of control at high speed; spinning in circles/one side; or the board failing to shut off, causing riders to jump off device, be thrown off, or crash into fixed objects.
- **Miscellaneous product-related issues** resulted in 3 of the 191 investigated incidents. In all 3 cases, the board vibrated excessively, throwing off the rider. Uneven weight distribution may have contributed to at least for 2 of these incidents.

E-Bikes

CPSC staff reviewed 107 completed investigation reports.

- **Fire hazard** was identified in 75 of the 107 e-bike incidents. Most reports (47 out of 75) describe the fires that started while being charged; an additional 6 incidents occurred while the battery was in a resting, non-charging state; another 3 incidents happened during use; 5 incidents (including 2 incidents at bike shops) were associated with product maintenance such as removing and replacing the battery; in 2 reports, incidents transpired shortly after product was powered on; in 2 other cases, hazards were related to faulty electrical wiring or overloading an extension cord; and, lastly, staff has insufficient information to determine whether the lithium battery was being charged or being removed from the e-bike for the remaining 8 incidents.
- **Miscellaneous product-related issues,** such as pedals, tires, wheels, and other structural integrity/design defect issues, were reported in 25 cases. Out of the 25, 11 reports were associated with pedals suddenly coming loose/separated off the crank of bike while riding; 7 out of 25 cases reported tire issues, such as ruptured tires, exploded/blown out tires, or cracked tires; additional 3 out 25 cases reported the front wheel detached without warning. In the other 4 cases, at least one of the following issues were reported: the frame collapsed, white powder formed around the battery terminals, the bike was shaky and wobblily, or the pin in the handlebars prevented making a left turn.
- **Brake issue** was reported in 4 incidents. Reports describe brakes malfunctioned/stopped working in 3 of the cases; the fourth report describes the

owner of the e-bike needing to “tighten” the brakes repeatedly until, on the day of the incident, the brakes failed completely.

- **Multiple product-related issues** were identified in 2 incidents as the consumer stated that he was having issues with the bicycle chain and the throttle; the motor stalled while he was riding the bicycle, causing him to fall.
- **Other electrical hazard** was reported in 1 incident. The report describes the rear wheel suddenly engaged and the e-bike started to move without notice.

Table 4.1 summarizes the hazards associated with the use of the various micromobility products as determined by the accidents investigated.

Table 4.1: In-Depth Investigations of Micromobility and Associated Hazards (2017–2023 Total)

Hazard	All Micromobility	E-Scooter (Dockless/rental)	Hoverboard	E-Bike
Fire Hazard	311	69 (1)	167	75
Brake Problem	36	32 (16)	0	4
Unexpected Power Loss	5	5 (5)	0	0
Other Electrical Hazard	25	3	21	1
Misc. Product-Related Issues	46	18 (3)	3	25
Control/Environmental/Unknown Factor	8	8 (4)	0	0
Multiple Product-Related Issues	10	8 (3)	0	2
Total	**441**	**143 (32)**	**191**	**107**

Source: CPSC In-Depth Investigation File from CPSRMS, 2017-2023.

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U.S. Census Bureau https://www.census.gov/
The Monthly Postcensal Resident Population counts can be found at: https://www2.census.gov/programs-surveys/popest/datasets/2020-2021/national/asrh/

Appendix A

Methodology

CPSC staff queried epidemiology data from NEISS and CPSRMS. Staff reviewed query results to include only the incidents related to micromobility products.

Date of Data Extraction: 4/22/2024

Date of NEISS Weight Update: 4/22/2024

Incident Dates or Treatment Dates: 1/1/17-12/31/23

Product codes and narrative descriptions

E-scooter:

- Product codes: 5042 (Scooters/skateboards, powered) in 2017-2019, 5022 (Scooters, Powered) from 2020 onwards, and 5024 (Scooters, Unspecified) as part of the 2020 through 2023 special studies.
- For the years: 2020 through 2023: 184 injury cases, originally coded as 5024 were identified to be e-scooters following investigations through the special study. These 184 cases were added to all injury cases coded under 5022. To account for the response rate of the special study, the weights for these 184 cases were recalibrated each year prior to derivation of the injury estimates.
- Narrative/Text contains any of the following: “electric scooter,” “e-scooter,” “stand up scooter,” “standup scooter,” “motorized scooter,” “power scooter,” “dockless scooter,” “rental scooter,” “scooter sharing,” any brand known to be dockless/rental e-scooters and other variant spellings.
- For CPSRMS data, searched brand and manufacturer fields when their information were available to identify in-scope products.

Hoverboard:

- Product code: 5042 (Scooters/skateboards, powered) in 2017–2019 and 5025 (Hoverboards and powered skateboards) from 2020 onwards.
- Narrative/Text contains any of the following: “self-balancing scooter,” “hoverboard,” and other varied spellings.
- For CPSRMS data, searched brand and manufacturer fields when their information were available to identify in-scope products.

E-bike:

- Product code: 3215 (Mopeds or power-assisted cycles) in 2017-2023

- Narrative/Text contains any of the following: “electric bike,” “e-bike,” “electric bicycle,” “e-bicycle,” “power (assisted) bike,” “power (assisted) bicycle,” “motorized bike,” “motorized bicycle,” and other varied spellings.
- For CPSRMS data, searched brands and manufacturer fields when their information was available to identify in-scope products.

For this report, an incident was deemed out of scope if any of the following criteria were satisfied:

- not electric or battery-powered
- not two-wheeled
- seated scooters
- mopeds, motorcycle
- mobility scooter/wheelchair
- any brand names that are not associated with micromobility products
- incidents occurred outside of the U.S.

For CPSRMS data, CPSC staff consolidated multiple reports that pertain to a single incident as one incident prior to analysis.

Raking Methodology and Raked Injury Estimate

This section summarizes the techniques implemented in this study to handle the nonresponse and to generate estimates of injuries. A unit nonresponse occurs when an assigned (sampled) subject cannot be reached or refuses to participate. In this case, no information is collected from the subject. In calculating the number of emergency department-treated, e-scooter-related injuries based on the results of this study, the biggest area of concern is unit nonresponse.

A popular method of dealing with unit nonresponse is raking, also known as "raking ratio estimation" or "sample balancing." This method uses an iterative proportional fitting algorithm to adjust weights to known population marginal totals to handle unit nonresponse within the survey. Further information can be found in (Tu and Garland 2012).

From January 1, 2023, to December 31, 2023, CPSC staff conducted a special study for injuries related to the NEISS product codes 5022 (Scooters, powered), and 5024 (Scooters, unspecified). The product code 5022 is used when an emergency department-treated injury is reported to have been associated with an e-scooter, whereas the product code 5024 is used when a specific type of scooter is unknown. Any injury in the specified timeframe that had a corresponding product code of either 5022 or 5024 were assigned for a follow-up survey. Many surveys were not completed due to missing contact information for the victim, inability to contact a victim that had contact information available, or a victim's refusal to participate. Raking was implemented to handle this type of nonresponse. The weights recorded for nonresponding

subjects are distributed among the subjects with completed surveys. That is, raking adjusts the weights of the completed surveys to compensate for the nonresponse.

To handle the nonresponse in this study via raking, the demographic variables, such as sex, age, race, hospital size (stratum), and e-scooter response rate, were used to rake the sample against the assigned marginal totals. The following variables had multiple-level responses and had to be collapsed into categories to limit the number of possible combinations to a manageable number: age, race, and stratum. Age variable was split into two age groups: “13 years old or younger” and “Over 13 years old”; Race into “White,” “Other race,” and “Not stated”; Stratum was grouped into “Very large and Children’s hospitals” and “Other hospitals.” Estimates for e-scooter-related, emergency department-treated injuries can be determined based on the information collected for each completed survey. Raking uses the population marginal totals for all the aforementioned variables. For this study, the population marginal totals were generated through the NEISS database using the data known for all assigned cases for this special study survey. Using the corresponding weights, the population marginal totals can be obtained. The survey weights within the study were raked (adjusted) to match the population marginal totals for each variable. The raking macro (Izreal, Hoaglin, & Battaglia) was used to generate the raked weights.

Appendix B

Summary of Annual Injury Estimates and Trend Analysis

Statistically significant year-to-year estimated ED visits:

All Micromobility Products

- For 2023, estimated ED visits were significantly higher than for any of the following years: 2017 (p-value: < 0.01), 2018 (p-value: < 0.01), 2019 (p-value: < 0.01), and 2020 (p-value: < 0.01).
- For 2022, estimated ED visits were significantly higher than for any of the following years: 2017 (p-value: < 0.01), 2018 (p-value: < 0.01), 2019 (p-value: < 0.01), 2020 (p-value: < 0.01), and 2021 (p-value: < 0.01).
- For 2021, estimated ED visits were significantly higher than for any of the following years: 2017 (p-value: < 0.01), 2018 (p-value: < 0.01), 2019 (p-value: 0.03), and 2020 (p-value: < 0.01).
- For 2020, estimated ED visits were significantly higher than for 2017 (p-value: < 0.01).
- For 2019, estimated ED visits were significantly higher than for any of the following years: 2017 (p-value: < 0.01) and 2018 (p-value: 0.05).
- For 2018, estimated ED visits were significantly higher than for 2017 (p-value: 0.01).

E-Scooters

- For 2023, estimated ED visits were significantly higher than for any of the following years: 2017: (p-value: < 0.01), 2018 (p-value: < 0.01), and 2020 (p-value: 0.05). In addition, estimated ED visits were significantly lower than for 2022 (p-value: 0.01).
- For 2022, estimated ED visits were significantly higher than for any of the following years: 2017 (p-value: < 0.01), 2018 (p-value: < 0.01), 2019 (p-value: < 0.01), and 2020 (p-value: < 0.01).
- For 2021, estimated ED visits were significantly higher than for any of the following years: 2017 (p-value: < 0.01), 2018 (p-value: < 0.01), and 2020 (p-value: < 0.01).
- For 2020, estimated ED visits were significantly higher than for 2017 (p-value: < 0.01).
- For 2019, estimated ED visits were significantly higher than for any of following years: 2017 (p-value: < 0.01) and 2018 (p-value: < 0.01).
- For 2018, estimated ED visits were significantly higher than for 2017 (p-value: 0.05).

Hoverboards

- For 2023, estimated ED visits were significantly lower than for any of the following years: 2017 (p-value: < 0.01), 2018 (p-value: < 0.01), 2019 (p-value: < 0.01), 2020 (p-value: < 0.01), and 2021 (p-value: < 0.01).
- For 2022, estimated ED visits were significantly lower than for any of the following years: 2017 (p-value: 0.03), 2018 (p-value: < 0.01), 2019 (p-value: < 0.01), 2020 (p-value: < 0.01), and 2021 (p-value: < 0.01).
- For 2021, estimated ED visits were significantly lower than for 2020 (p-value: 0.04).
- For 2020, estimated ED visits were significantly higher than for 2019 (p-value: 0.02).
- For 2019, estimated ED visits were significantly lower than for 2018 (p-value: 0.03).

E-bikes

- For 2023, estimated ED visits were significantly higher than any of the following years: 2017 (p-value: < 0.01) and 2022 (p-value: < 0.01).
- For 2022, estimated ED visits were significantly higher than for 2017 (p-value: < 0.01).

Annual Injury Estimates, Corresponding Sample Sizes, and Coefficients of Variation by Product Type, 2017-2023

Year	All Micromobility			E-Scooter			Dockless/Rental E-Scooter			Hoverboard			E-Bike		
	N	Est. ED Visits	C.V.	N	Est. ED Visits	C.V.	N	Est. ED Visits	C.V.	N	Est. ED Visits	C.V.	N	Est. ED Visits	C.V.
2017	935	34,000	0.11	185	7,700	0.18	--	--	--	683	22,800	0.11	67	3,500	0.32
2018	1,149	44,000	0.12	369	14,500	0.25	47	1,800	0.80	714	26,300	0.13	66	3,200	0.48
2019	1,561	54,800	0.15	761	27,700	0.27	163	4,900	0.59	664	22,100	0.16	136	5,000	0.36
2020	1,690	57,700	0.17	652	25,400	0.28	78	3,400	0.27	922	27,100	0.14	116	5,200	0.41
2021	2,030	77,200	0.18	945	42,200	0.23	216	11,200	0.34	794	23,100	0.18	290	11,800	0.35
2022	2,440	93,100	0.15	1,413	51,700	0.15	199	7,900	0.32	490	17,100	0.20	537	24,400	0.27
2023	2,506	87,800	0.13	1,308	40,400	0.14	252	7,900	0.36	374	13,300	0.15	824	34,200	0.20
Total	**12,311**	**448,600**	**0.13**	**5,634**	**209,600**	**0.16**	**955**	**37,200**	**0.29**	**4,641**	**151,600**	**0.14**	**2036**	**87,400**	**0.26**

Source: NEISS, U.S. Consumer Product Safety Commission, 2017-2023.
Grey shaded cells in the table do not meet the NEISS reportability criteria. Reporting criteria for NEISS require that the estimated number of injuries be 1,200 or higher, the sample size be 20 or larger, and the coefficient of variation be less than 33 percent (C.V. less than 0.33 in table).
-- Staff did not identify any dockless/rental scooters in the 2017 NEISS data.

Trend Analysis

Staff observed significant increases for all micromobility product-related injuries from 2017 to 2023. A statistically significant trend was observed (p-value: < 0.01).

Trend Analysis Results Based on Unstructured Variance/Covariance Matrix

Effect	Parameter Estimate	Standard Error	Degrees of Freedom	t-value	p-value
Intercept	-12,420,000	2,551,047	5	-4.87	< 0.01
Year	6,173	1,264	5	4.88	< 0.01

Source: NEISS, U.S. Consumer Product Safety Commission, 2017-2023.

Appendix C

Updated 2022 Special Study Results

Since the publication of the previous annual report in 2022, staff received 24 additional e-scooter cases. The updated tabulations are presented below.

Table C3.1: Scooter Products: NEISS Product Code vs. Verified Scooter Product (2022)

Verified Product	Overall	Powered Scooter (5022)	Unspecified Scooter (5024)	Various Other Product Codes
Kick (unpowered) Scooter	28	9	19	0
Mobility Scooter	29	28	0	1
Moped	32	28	4	0
Hoverboard	2	0	2	0
E-Scooter	333	308	25	0
Gas powered scooter	8	8	0	0
Other/missing	27	20	4	3
Total	459	401	54	4

Source: NEISS, U.S. Consumer Product Safety Commission, 2022.
Based on responses from the special study survey questions V3–V8.

Table C3.2: Completed E-Scooter Investigations by Powered vs. Unspecified Scooter (2022)

Investigation	Overall	Percent	Powered Scooter (5022)	Percent	Unspecified Scooter (5024)	Percent
Completed Investigation	333	9%	308	19%	25	1%
Incomplete/Out of Scope	3,386	91%	1,309	81%	2,058	99%
Total Assigned	3,719	100%	1,617	100%	2,083	100%

Source: NEISS, U.S. Consumer Product Safety Commission, 2022.

Table C3.3: Distribution of Estimated Injuries by Rental Status (2022)

Rental vs Non-rental	N	Estimated ED-treated Injuries+	Percent
Rental	154	17,400	34%
Non-rental/Unspecified	179	34,300	66%
Total	333	51,700	100%

Source: NEISS, U.S. Consumer Product Safety Commission, 2022.
Based on the responses from special study survey question: *S1 Which of the following best describes the scooter? Rental, Owned by victim, Borrowed, Other, Don't know.*
+ Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.

Table C3.4: Distribution of Estimated Injuries by How Victim Was Injured (2022)

Riding/Struck by Scooter	N	Estimated ED-treated Injuries+	Percent
Riding the scooter	316	48,700	94%
Struck by scooter	7	*	*
Other	10	1,900	4%
Total	333	51,700	100%

Source: NEISS, U.S. Consumer Product Safety Commission, 2022.
Based on the responses from special study survey question: *V10 You/the victim were/was: Riding the scooter; Struck by scooter; Other.*
+ Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.
* Estimated ED-treated injuries under 1,200.

Table C3.5: Distribution of Estimated Injuries by Type of Riding Surface (2022)

Type of Surface	N	Estimated ED-treated Injuries+	Percent
Paved road	213	33,400	65%
Paved sidewalk	93	13,900	27%
Driveway	5	*	*
Other	17	2,600	5%
Unspecified	8	1,400	3%
Total	333	51,700	100%

Source: NEISS, U.S. Consumer Product Safety Commission, 2022.
Based on the special study survey question: *A3 What type of surface were you/the victim on?*
+ Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates; column values may not add up to column totals due to rounding or because some riders may have ridden e-scooter on more than one surface type.
* Estimated ED-treated injuries under 1,200.

Table C3.6: Distribution of Estimated Injuries by Visibility (2022)

Visibility Issues	N	Estimated ED-treated Injuries+	Percent
Yes	89	12,600	24%
No	237	37,800	73%
Unspecified	7	1,300	3%
Total	333	51,700	100%

Source: NEISS, U.S. Consumer Product Safety Commission, 2022.
Based on the special study survey question: *A5 Was it dark or difficult to see?*
+ Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.

Table C3.7: Distribution of Estimated Injuries by Distraction (2022)

Distraction	N	Estimated ED-treated Injuries+	Percent
Yes	25	4,700	9%
No	298	45,400	88%
Unspecified	10	1,600	3%
Total	333	51,700	100%

Source: NEISS, U.S. Consumer Product Safety Commission, 2022.
Based on responses to the special study survey question: *A6 Was there anything else occurring at the time of the accident such as music, cell phone interference, or loud music?*
+ Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.
* Estimated ED-treated injuries under 1,200.

Table C3.8: Distribution of Estimated Injuries by Rider Baggage (2022)

Carrying/holding something	N	Estimated ED-treated Injuries+	Percent
Yes	105	14,300	28%
No	209	33,500	65%
Unspecified	19	3,800	7%
Total	333	51,700	100%

Source: NEISS, U.S. Consumer Product Safety Commission, 2022.
Based on responses to the special study survey question: *A8 Was there anything else occurring at the time of the accident such as music, cell phone interference, or loud music?*
+Injury estimates are rounded to the nearest 100 and may not sum to totals due to rounding. Percentages are calculated from the unrounded estimates.

Table C3.9: Distribution of Estimated Injuries by Safety Equipment (2022)

Safety equipment	N	Estimated ED-treated Injuries+	Percent
Helmet	52	10,100	20%
Blinking Lights/Head lamp	143	20,600	40%
Reflective vest	9	*	*
Knee/elbow pads	9	1,800	3%
Other	6	2,100	4%
None of the above/ Unspecified	166	24,700	48%
Total	333	51,700	100%

Source: NEISS, U.S. Consumer Product Safety Commission, 2022.
Based on responses from the special study survey question: *S12 I'm going to read a list of safety equipment that riders might wear. Please tell me if the rider was wearing any of these at the time of the incident.*
Riders may use more than one type of safety equipment; as such, rows do not add up to total.
+ Injury estimates are rounded to the nearest 100. Percentages are calculated from the unrounded estimates.
* Estimated ED-treated injuries under 1,200.

Special Study Survey Questionnaire

Q1 The U.S. Consumer Product Safety Commission (CPSC) collects data through the National Electronic Injury Surveillance System (NEISS) on injuries treated in hospital emergency departments. CPSC conducts follow-up investigations with a small number of people to learn more about how the injury occurred. The results of these investigations will be used to determine if similar injuries can be prevented in the future.

Your participation in this survey is completely voluntary and your identity and answers will be strictly confidential. This survey will take between 10-15 minutes and data are used for statistical purposes only.

You should have received a letter with the following information needed to continue:
1. Investigation Task Number
2. Randomly generated password

To continue, you will have to enter the task number correctly below:

I1 CPSC would prefer that the person who answers this questionnaire is the actual person injured and treated in the hospital emergency department. If the injured person is under the age of 16, CPSC would prefer that a parent or guardian completes the questionnaire.

Was the injured person 16 years old or older?

Note: If you are the injured person and are under 16, please ask your parent or guardian to complete the survey. If no one is available, it is okay to respond yourself.
o Yes (1)
o No (2)

I2 According to our records from the National Electronic Injury Surveillance System the injured person was seen on {injury date} in the emergency department at {hospital name} for an injury that involved a scooter. Is that correct?
o Yes (1)
o No (2)
o Don't know (3)

I3 What information is incorrect from the statement above?
- Different date (1)
- Different hospital (2)
- (I/the victim) did not receive treatment in a hospital emergency department for a scooter injury (3)

I4 What is the correct date?

I5 Where did you/the victim receive treatment for your/their injury?

V1 Are you the:
o Injured person (1)
o Parent or guardian of injured person (2)
o Other (specify in next window) (3)

V2 Specify relationship:

V3 Was the scooter unpowered (e.g., a kick scooter or push scooter)?
Note: Powered scooters have a power source like electric or gas.
o Yes (1)
o No (2)
o Don't know (4)

V4 Was the scooter an assisted mobility scooter to help people with physical limitations?
o Yes (1)
o No (2)

V5 Was the scooter a moped, motorcycle, or scooter that requires a registration or license?
o Yes (1)
o No (2)

V6 Did the scooter have handles for steering?
Note: Handles for steering are distinct from handles used for balancing purposes.
o Yes (8)
o No (9)

V7 If your scooter had only two wheels, were those wheels side-by-side?

Note: side-by-side wheels are distinct from wheels that are one in front of the other. Below is an example of side-by-side wheels.
o Yes (1)
o No (2)

V8 What kind of power did the scooter run on?
o Gas (1)
o Electric (2)
o Other (specify in next window) (3)

V9 Specify.

V10 You/the victim were/was:
Interviewer instruction: If two scooters collided select "Riding the scooter."
o Riding the scooter (1) o Struck by scooter (2) o Other (specify) (3)

V11 Specify.

A1 Please describe how the accident happened. That is, what were you/the victim doing just before, during, and just after the injury occurred? Please specify the location of the accident and any environmental factors; such as weather, temperature, and anything else that may have contributed to the accident.

A2 The following are specific questions about the incident that you may have already described. Please bear with us as you fill out the next set of questions.

A3 What type of surface were you/the victim on?
- ○ Paved Road (1)
- ○ Paved Sidewalk (2)
- ○ Gravel (3)
- ○ Grass (4)
- ○ Driveway (5)
- ○ Other (specify in next window) (6)
- ○ Don't know (7)

A4 Specify.

A5 Was it dark or difficult to see?
o Yes (1)
o No (2)
o Don't know (3)

A6 Was there anything else occurring at the time of the accident such as music, cell phone interference, or loud music?
o Yes (1)
o No (2)
o Don't know (3)

A7 Please specify the additional factors.

A8 Were/was you/the victim carrying or holding something such as a bag, purse, or backpack?
o Yes (1)
o No (2)
o Don't know (3)

A9 What were/was you/the victim carrying?

A10 Which of the following best describes how you were injured?
o Hit from the front (1)
o Hit from the side (2)
o Hit from behind (3)
o Other (specify in next window) (4)
o Don't know (5)

A11 Specify.

A12 Was there any warning before you/the victim were/was hit? (ex. bell, shouting, or other noise)
o Yes (1)
o No (2)
o Don't know (3)

S1 Which of the following best describes the scooter?
o Rental (1)
o Owned by victim (2)
o Borrowed (3)
o Other (specify in next window) (4)
o Don't know (5)

S2 Specify.

S3 Who was the scooter rented from?

S4 Do you know the brand and model names of the scooter or have a photo of the scooter involved in the injury?
o Yes (1)
o No (2)

S5 Specify brand

S6 Specify model
Note: if brand is known but model is not, enter unknown below

S7 If you are able, please upload a photo of the scooter.

S8 It is very important for us to know what brands are involved in these injuries. Would you be willing to go look at the scooter and record the brand name, model name, and take a photo of the scooter?

Note: You may also upload a pre-existing photo of the scooter if you have one. Select 'Yes' if you have a pre-existing photo.
o Yes (1)
o No (2)

S9 Specify brand

S10 Specify model

Note: if brand is known but model is not, enter unknown below

S11 If you are able, please upload a photo of the scooter.

S12 Were/was you/the victim wearing any of these at the time of the incident. (Select all that apply)
- ○ Helmet (1)
- ○ Knee pads (2)
- ○ Elbow pads (3)
- ○ Wrist pads (4)
- ○ Reflective vest (5)
- ○ Blinking lights/Head lamp (6)
- ○ Other (specify in next window) (7)
- ○ None of the above (8)

S13 Specify.

C1 Is there anything else about this accident or the scooter involved that you would like to share?
o Yes (1)
o No (2)

C2 Explain.

C3 The following race and ethnicity questions will help the U.S. Consumer Product Safety Commission better focus outreach and education efforts related to e-scooter safety.

C4 Are you/the victim Hispanic or Latino?
o Yes (1)
o No (2)
o Don't know (3)
o Prefer not to answer (4)

C5 What race(s) do you consider yourself to be? Please check all that apply.
- ○ White (1)
- ○ Black or African American (2)
- ○ American Indian or Alaska Native (3)
- ○ Asian (4)
- ○ Native Hawaiian or Pacific Islander (5)
- ○ Other (6)
- ○ Don't Know (7)
- ○ Prefer not to answer (8)

C6 Please specify "Other" race. Please be as specific as possible.

C7 We may be interested in sending a CPSC investigator to your home to gather more information about how the accident occurred and take more detailed pictures of the scooter. This investigation would be set up at your convenience. May we have an investigator contact you by phone to setup a visit?
o Yes (1)
o No (2)

C8 Please supply your phone number.

C9 When is a good time to call? (Check all that apply.)
- ○ Morning (1)
- ○ Afternoon (2)
- ○ Evening (3)